INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/000040

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: H04R 1/28, H04R 3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, USPTO: LOUDSPEAKER, TRANSDUCER, ENCLOSURE, RESPONSE, EQUALIZER AND SIMILAR TERMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2254221 A (MACAULAY) 30 September 1992 whole document	1-40
Y	US 6389146 B1 (CROFT,III) 14 May 2002 whole document	1-40
Y	US 5109422 A (FURUKAWA) 28 April 1992 whole document	1-40
Y	US 5361381 A (SHORT) 1 November 1994 whole document	1-40

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
30 January 2004

Date of mailing of the international search report
= 9 FEB 2004

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0122663 A2 (FREADMAN) 24 October 1984 whole document	1-40

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2004/000040

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	2254221	NONE					
US	6389146	AU	16268/00	AU	39786/01	CA	2400423
		EP	1188353	EP	1256259	US	6169811
		WO	0052978	WO	0162043		
US	5109422	EP	0361445				
US	5361381	NONE					
EP	0122663	JP	60041395				

END OF ANNEX

STATEMENT UNDER ARTICLE 19 (1)

1. Delete the claims presently on file and insert new claims 1-38 filed herewith in duplicate.

AMENDED CLAIMS
[received by the International Bureau on 6 May 2004 (06.05.04);
original claims 1 to 40 replaced by new claims 1 to 38 (5 pages)]

1. A loudspeaker system suitable for a confined space including:

an electro-acoustic transducer having a relatively low value of Qt, wherein Qt denotes total quality factor of resonant behaviour of said electro-acoustic transducer, including electrical and mechanical quality factors;

an enclosure for said electro-acoustic transducer, said enclosure having a second order topology which is naturally inclined to produce a rising acoustic response for said system at a second order rate, said enclosure further having means adapted to interface said confined space for modifying a rate of rise of said response relative to said second order rate such that said response is attenuated relative to said second order rate but is accentuated relative to a substantially flat response within a substantial part of a passband of said system, said accentuation being most significant at a selected frequency or frequencies near a high end of said passband, said interface means being further arranged to filter harmonics out of said acoustic response to reduce distortion; and

means included in an electrical path driving said electro-acoustic transducer for equalizing said rising response to be substantially flat overall and to provide extended dynamic headroom at least at said selected frequency or frequencies.

2. A loudspeaker system according to claim 1 wherein said second order rate is substantially 12dB/octave and said attenuated response is not more than substantially 9dB/octave.

3. A loudspeaker system according to claim 1 or 2 wherein said attenuated response is substantially 6dB/octave.

4. A loudspeaker system according to claim 1, 2 or 3 wherein said interface means includes a first acoustic filter.

5. A loudspeaker system according to claim 4 wherein said first acoustic filter includes a helmholtz resonator.

6. A loudspeaker system according to any one of the preceding claims wherein said selected frequency or frequencies is/are near a higher frequency end of said passband.

7. A loudspeaker system according to any one of the preceding claims wherein said enclosure includes backwave barrier means adapted to exclude from said confined space sound generated from a side of said transducer opposing said space.

8. A loudspeaker system according to claim 7 wherein said backwave barrier means includes an acoustically leaky element.

9. A loudspeaker system according to claim 7 wherein said backwave barrier means includes a sealed or acoustically leaky cavity built into a motor vehicle.

10. A loudspeaker system according to claim 9 wherein said backwave barrier means includes a wall of a trunk of said vehicle.

11. A loudspeaker system according to claim 9 or 10 wherein said backwave barrier means includes a rear parcel shelf of said vehicle.

12. A loudspeaker system according to any one of claims 8 to 11 wherein said leaky element causes at least partial sound field cancellation outside of said confined space.

13. A loudspeaker system according to any one of the preceding claims wherein said equalizing means is adapted to attenuate said rising response at least at said selected frequency or frequencies.

14. A loudspeaker system according to any one of the preceding claims wherein said equalizing means includes a two pole filter.

15. A loudspeaker system according to any one of the preceding claims wherein such equalizing means is included with an inverter amplifier combination used for driving said electro-acoustic transducer.

16. A loudspeaker system according to any one of claims 4 to 15 wherein said first acoustic filter interacts with a first side of said electro-acoustic transducer and including a second acoustic filter adapted to interact with a second side of said electro-acoustic transducer opposing said first side.

17. A loudspeaker system according to claim 16 wherein said second acoustic filter is adapted to modify phase and/or amplitude of a backwave generated by said electro-acoustic transducer.

18. A loudspeaker system according to claim 16 or 17 wherein said second acoustic-filter is adapted to enhance cancellation of a sound field attributable to said system that is external to said space.

19. A method of extending output of a loudspeaker system suitable for a confined space, said method including:

providing an electro-acoustic transducer having a relatively low value of Qt, wherein Qt denotes total quality factor of resonant behaviour of said electro-acoustic transducer including electrical and mechanical quality factors;

providing an enclosure for said electro-acoustic transducer, said enclosure having a second order topology which is naturally inclined to produce a rising acoustic response for said system at a second order rate;

interfacing said enclosure to said confined space to modify said rising response relative to said second order rate such that said response is attenuated relative to said second order rate but is accentuated relative to a substantially flat response within a substantial part of a passband of said system, said accentuation being most significant at a selected frequency or frequencies near a high end of said passband, said interfacing being further arranged to filter harmonics out of said acoustic response to reduce distortion; and

electrically equalizing said rising response to be substantially flat overall and to provide extended dynamic headroom at least at said selected frequency or frequencies.

20. A method according to claim 19 wherein said second order rate is substantially 12dB/octave and said attenuated response is not more than substantially 9dB/octave.

21. A method according to claim 19 or 20 wherein said attenuated response is substantially 6dB/octave.

22. A method according to claim 19, 20 or 21 wherein said interfacing is performed via a first acoustic filter.

23. A method according to claim 22 wherein said first acoustic filter includes a helmholtz resonator.

24. A method according to any one of claims 19 to 23wherein said selected frequency or frequencies is/are near a higher frequency end of said passband.

25. A method according to any one of claims 19 to 24 wherein said enclosure includes backwave barrier means adapted to exclude from said confined space sound generated from a side of said transducer opposing said space.

26. A method according to claim 25 wherein said backwave barrier means includes an acoustically leaky element.

27. A method according to claim 25 wherein said backwave barrier means includes a sealed or acoustically leaky cavity built into a motor vehicle.

28. A method according to claim 27 wherein said backwave barrier means includes a wall of a trunk of said vehicle.

29. A method according to claim 27 or 28 wherein said backwave barrier means includes a rear parcel shelf of said vehicle.

30. A method according to any one of claims 26 to 29 including utilizing said leaky element to at least partially cancel a sound field attributable to said system that is external to said confined space.

31. A method according to any one of claims 19 to 30 wherein said equalizing is adapted to attenuate said rising response at least at said selected frequency or frequencies.

32. A method according to any one of claims 19 to 31 wherein said equalizing is performed via a two pole filter.

33. A method according to any one of claims 19 to 32 wherein such equalizing is performed by means included with an inverter amplifier combination used for driving said electro-acoustic transducer.

34. A method according to any one of claims 22 to 33 wherein said first acoustic filter interacts with a first side of said electro-acoustic transducer and including providing a second acoustic filter adapted to interact with a second side of said electro-acoustic transducer opposing said first side.

35. A method according to claim 34 wherein said second acoustic filter is adapted to modify phase and/or amplitude of a backwave generated by said electro-acoustic transducer.

36. A method according to claim 34 or 35 wherein said second acoustic-filter is adapted to enhance cancellation of a sound field attributable to said system that is external to said space.

37. A loudspeaker system substantially as herein described with reference to Figs. 2 to 6 of the accompanying drawings.

38. A method of extending output of a loudspeaker system substantially as herein described with reference to Figs. 2 to 6 of the accompanying drawings.